zoic acids, but the chemical deportment of these substances is altogether different from that of the analogous derivatives of acetic acid.

Further experiments are necessary to establish this view; the existence of two varieties of lactic acid, and of alanine and sarcosine, which are both represented by the formula

$$C_3\,H_7\,NO_2,$$

appears to indicate that similar isomerisms obtain also in the group of fatty acids.

The above observations were collected in Dr. Hofmann's laboratory.

VIII. "On the Ureas of the Diamines." By J. VOLHARD, Ph.D. Communicated by Dr. HOFMANN. Received May 24, 1861.

The action of cyanic acid and of the cyanic ethers on the monamines gives rise to the formation of the substances known as the *compound ureas*. By substituting diamines for the monamines in the above reaction, I have succeeded in producing a series of compound ureas of a higher order, which are remarkable for their well-defined properties and for their characteristic decompositions.

Dichloride of ethylene-diammonium is readily attacked by cyanate of silver. On evaporating the solution, separated from the chloride of silver, a new substance crystallizing in prisms is obtained, which I designate as *ethylene-urea*. This body is soluble in water and alcohol; it contains

$$C_4\,H_{10}\,N_4\,O_2 = \left.\begin{matrix}(CO)_2''\\(C_2\,H_4)''\\H_6\end{matrix}\right\}N_4{}^*,$$

and is formed by one molecule of ethylene-diamine combining with two molecules of cyanic acid.

Ethylene-urea fuses at 192° C. It dissolves easily and without decomposition in hydrochloric or nitric acid, without, however, combining with these acids; the acid solutions, when evaporated to dryness, leave the pure ethylene-urea. When boiled with a very concentrated solution of potassa, this body assimilates the elements of water and splits into carbonic acid, ammonia, and ethylene-diamine,

$$C_4\,H_{10}\,N_4\,O_2 + 4\,KHO = 2\,K_2\,CO_3 + 2\,H_3\,N + C_2\,H_8\,N_2.$$

* $H=1$; $O=16$; $C=12$, &c.

Ethylene-urea combines with dichloride of platinum and trichloride of gold.

The platinum-compound is obtained in short prisms of orange-red colour, containing

$$C_4 H_{10} N_4 O_2, H Cl, Pt Cl_2.$$

The gold-salt crystallizes in golden-yellow scales of the composition

$$C_4 H_{10} N_4 O_2, H Cl, Au Cl_3.$$

The analysis of these compounds fixes the molecular value of the new urea. It deserves to be noticed, that this body, although derived from four molecules of ammonia, exhibits nevertheless in its combining power the character of but one molecule of ammonia; it is a *monacid tetramine*.

Diethylated Ethylene-ureas.

When cyanate of silver is treated with dibromide of ethylene-diethyl-diammonium, a reaction perfectly analogous to that observed between cyanate of silver and dichloride of ethylene-diammonium is accomplished. The solution, when separated from the bromide of silver and evaporated, solidifies on cooling to a crystalline mass. The new substance may be easily purified by dissolving it in absolute alcohol, from which it is deposited in the form of colourless needles, exceedingly soluble both in water and alcohol. The diethylated urea contains

$$C_8 H_{18} N_4 O_2 = \left.\begin{matrix} (C O)_2'' \\ (C_2 H_4)'' \\ (C_2 H_5)_2 \\ H_4 \end{matrix}\right\} N_4.$$

This urea fuses at 124°, decomposing, however, partially at this temperature.

It forms a platinum-salt,

$$C_8 H_{18} N_4 O_2, H Cl, Pt Cl_2,$$

and a gold-salt of very little stability, which could not be analysed.

Cyanate of ethyl acts most energetically on ethylene-diamine. If the cyanate be poured into ethylene-diamine, each drop hisses like red-hot iron plunged into water. The mixture solidifies into a mass of needles, which, when recrystallized from water or spirit, furnish the

new compound in a state of purity. The substance thus obtained presents the same composition as the product of the action of dibromide of ethylene-diethyldiammonium on cyanate of silver, viz.

$$C_8 H_{18} N_4 O_2.$$

The two ureas, however, are far from being identical. The urea obtained by combining cyanate of ethyl with ethylene-diamine is easily soluble in boiling water, difficultly soluble in cold water, even less soluble in spirit, and almost insoluble in absolute alcohol. It fuses, without decomposition, at 201°, solidifying again at 185°. This body is altogether indifferent. I did not succeed in obtaining a platinum-salt or a gold-salt of this urea, while the isomeric substance, derived from ethylene-diethylamine, furnishes both salts without difficulty.

The non-identity of the two bodies is thus sufficiently established, but the absolute difference in their construction is most conspicuously manifested in the products of decomposition, which they yield under the influence of the alkalies. Treated with potash, the urea, derived from ethylene-diethyldiamine and cyanic acid, yields ethylene-diethyldiamine and the products of decomposition of cyanic acid, carbonic acid and ammonia:

$$C_8 H_{18} N_4 O_2 + 4 K H O = 2 K_2 C O_3 + 2 H_3 N + C_6 H_{16} N_2.$$

The urea, on the other hand, which is formed by the action of ethylene-diamine on cyanic ether, splits into ethylene-diamine and the derivatives of cyanic ether, carbonic acid and ethylamine:

$$C_8 H_{18} N_4 O_2 + 4 K H O = 2 K_2 C O_3 + 2 C_2 H_7 N + C_2 H_8 N_2.$$

It is thus evident that the two individual groups of elements, the union of which gives rise to the two different ethylated ethylene-ureas, remain as such unaltered in these compounds.

The observations which I have recorded render it very probable that many of those substances known as compound ureas, and hitherto supposed to be identical, might on closer examination prove to be isomeric only.

Diethylurea, obtained by treating cyanate of ethyl with ethylamine or with water, differs indeed most conspicuously in its properties from diethylurea, produced by the action of cyanic acid on diethylamine. Under the influence of potash these two bodies split, the one into carbonic acid and ethylamine, the other into carbonic acid, ammonia, and diethylamine. Even the ethylurea, prepared by cyanic

acid and ethylamine, differs in some of its physical properties from the ethylurea obtained by the action of ammonia on cyanic ether, although both substances yield under the influence of chemical agents exactly the same products of decomposition, viz. carbonic acid, ammonia, and ethylamine.

The experiments described in this Note were made in Dr. Hofmann's laboratory.

IX. "Notes of Researches on the Poly-Ammonias."—No. XI. Isomerism of Diatomic Compounds. By A. W. Hofmann, LL.D., F.R.S. Received May 24, 1861.

The experiments which Dr. Volhard has described in the previous Note, remind me of some analogous observations which I made some time ago in the case of oxalyl-derivatives.

While engaged in experiments on the separation of the ethyl bases by means of oxalic ether, which I have had the honour of laying before the Royal Society *, I had collected a considerable quantity of diethyloxamate of ethyl,

$$C_8 H_{15} NO_3 = \left.\begin{matrix}[(C_2 O_2)'' (C_2 H_5)_2 N] \\ (C_2 H_5)\end{matrix}\right\} O,$$

which is formed by the action of oxalic ether upon diethylamine. I have studied the deportment of this compound under the influence of several agents.

When digested with alcoholic ammonia in sealed tubes, diethyloxamate of ethyl is rapidly converted into a crystalline compound, which on analysis was found to contain

$$C_6 H_{12} N_2 O_2,$$

showing that the reaction is accomplished in the form pointed out by theory,

$$\left.\begin{matrix}(C_2 O_2)'' (C_2 H_5)_2 N \\ (C_2 H_5)\end{matrix}\right\} O + H_3 N = \left.\begin{matrix}(C_2 O_2)'' \\ (C_2 H_5)_2 \\ H_2\end{matrix}\right\} N_2 + \left.\begin{matrix}C_2 H_5 \\ H\end{matrix}\right\} O.$$

The new compound then has the composition of diethyloxamide, but it is far from being identical with the splendid body which is formed by the action of oxalic ether on ethylamine. It differs from the latter in many of its properties, being in fact much more soluble

* Proceedings, vol. xi. p. 66.